Foreword

The "DNA Revolution" may be said to have been ignited in 1944 with the discovery that DNA could convey genetic information from one pneumococcal cell to another.[1] This iconoclastic insight was founded in clinically important investigations of the transmission of pneumococcal pneumonia, for which it was important to sort out different serotypes among the strains responsible. So this was an important indebtedness of basic science to the study of human disease.[2]

How long might it take, many have asked, for that debt to be repaid, for the arcana of DNA, read biotechnology, to be reduced to usable practice in medicine, public health, and agriculture? At the level of the most important fundamental insights, that process began a half-century ago with the gradual incorporation of "DNA" into common biological teaching and wisdom, and with the great boost of Watson and Crick's elucidation of DNA's double-helix structure in 1953.

It took perhaps until the late 1970s to find the reduction of DNA to practice, concrete therapeutic or diagnostic interventions that depended on DNA knowledge, e.g. Y.W. Kan's introduction of DNA typing for the antenatal diagnosis of sickle-cell Anemia.[3] The invention of PCR (polymerase chain reaction) assays hailed what was called the democratization of DNA research, and brought such studies within the purview of labs otherwise denied access to what had been an arcane technology.[4] In a somewhat different style, heavy technological metal was applied to the extraction of the human genome sequence, along with that of select other species — an epochal marker of the turn of the century.

With these enormous technical resources, the conscience of science now turns to their application for alleviating human grief, pain, mortality. Market mechanisms have worked reasonably well in advanced economies — for the allocation of resources from both public and private sectors. Investment in applications of biotechnology may approximate 0.1% of the GDP, or a few percent of the budget for health care. In the absence of market incentives, the needs of poor countries are not well met, and call for designed transfers, in concert (or competition) with allocations for broader economic development, infrastructure, education and military security.

That conscience has had expression in a number of venues, like the World Health Organization[5] and IUPAC's CHEMRAWN initiative, for applications of chemistry to world needs.[6]

Now we have a studious effort to tap expert opinion in posting attractive priorities in the application of biotechnology. This Delphi-like approach[7] has the expected virtues and shortcomings of relying upon consensus, more appropriate for policy choice in translational research than in predicting avenues of creative discovery. My own experience of forty years in technological forecasting supports the following paradox. The most linear technological trajectories are most likely to be complicated by unanticipated psychosocial and political trends, as often

as the converse[8]; and they may take two or three times as long as predicted. Revolutionary discontinuities appear out of nowhere, and change the world suddenly. Consider the evolution of the Soviet Union as a historic example; fiber optics another; and the most dramatic of the last century, antibiotics on one side; nuclear weaponry on the other.

The Delphi consensus hence offers few surprises – but authoritative assurance that there are enormous harvests to be expected from investment in by now well-worn paths to deal with infectious disease and the improvement of agriculture. While these are the most urgent challenges, the advanced technologies developed in response will also be applicable to chronic health conditions like cancer, depression and heart disease, and even to important industrial products (chemicals, advanced materials).

I do not repeat the lists, they are unlikely to be contentious.

Resistance may be expected from the following critical perspectives:

1. Guide investments more directly to economic development! A longstanding quarrel between ministers of finance vs. health.

2. Use the technologies already available, don't spend time developing new ones.

   - The unbearable costs of current medications for HIV
   - The resistance to mechanical barrier prophylaxis for STD's and contraception
   - The cumbersome burden of Directly Observed Therapy for tuberculosis
   - The paucity of environmentally acceptable pesticides for vector control

All illustrate serious shortcomings in existing technologies.

3. Developing indigenous capacity for decision-making and for technological competence is a higher priority that has to be respected in the implementation of the technical priorities;

   - There is not a necessary contradiction.

So now we need to recruit comparable brainpower towards the problem of mobilizing the political will to solve these problems. I have despaired of relying on spasmodic humanitarian impulses, and instead marshal the argument of self-interest! The satisfaction of local needs by no means guarantees a harmonious community, but the prevalence of hunger and disease guarantees instability and the festering of infection that eventually transcends borders.

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